Center Independent Research & Development: LaRC IRAD

Stratospheric Aerosol and Gas Experiment (SAGE) IV Pathfinder

Completed Technology Project (2014 - 2017)

Project Introduction

The Clean Air Act mandates NASA to monitor stratospheric ozone, and stratospheric aerosol measurements are vital to our understanding of climate. Maintaining reliable long-term measurements will require increasing access to and reducing the cost of frequent spaceborne missions. However, the best measurements have been and continue to be delivered via expensive, single instruments (e.g., SAGE II, SAGE III M3M, and SAGE III ISS launched in 2017) deployed onboard large, heavy platforms. Instead, a constellation of relatively inexpensive SAGE IV sensorcraft can maintain the stratospheric ozone record and provide critical measurements of stratospheric aerosol and other trace gases.

A solar occultation imager in a small form factor can provide high-quality science at a small fraction of the cost and even improve data quality in the upper troposphere / lower stratosphere. The imaging technique intrinsically eliminates all of the major technological and algorithmic challenges of previous solar occultation instruments, yet to date there has not been a radiometric solar occultation imager. The SAGE IV system design enables continuous on-orbit characterization of instrument behavior and performance. The majority of hardware is commercially available, and the entire payload can fit inside a 6U CubeSat. Current technology limits telemetered data volume from a CubeSat, but embedded control algorithms will be developed to ensure all raw science data is retained and transmitted.

The SAGE IV Pathfinder started out as an Internal Research and Development (IRAD) project at NASA Langley Research Center in Hampton, Virginia and was successfully infused into the NASA Instrument Incubator Program (IIP) under the NASA Earth Science Technology Office. Under IRAD, detailed design and analysis were performed to ensure viability and future success of the instrument and mission concepts. The SAGE IV Pathfinder IIP will build and test a ground demonstration unit over the next three years and is the first stepping stone to a future on-orbit mission.

Anticipated Benefits

In the late 20th century, scientists observed that stratospheric ozone, which blocks harmful ultraviolet radiation from reaching the Earth's surface, was rapidly declining as a result of the use of chlorofluorocarbons (CFCs). This led to the international adoption of the Montreal Protocol that banned CFCs and an amendment to the Clean Air Act that mandated NASA to monitor stratospheric ozone levels. Additionally, aerosol measurements are important for both their incorporation into climate models and their impact on commercial aviation following volcanic eruptions. SAGE IV will be capable of maintaining these critical measurements but in an innovative and sustainable way that drastically reduces size and cost.

Stratospheric Aerosol and Gas Experiment (SAGE) IV Pathfinder

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

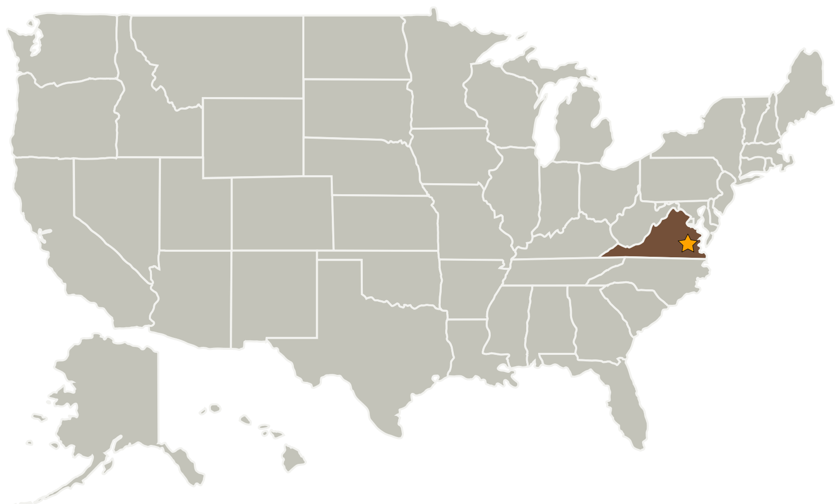
Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Independent Research & Development: LaRC IRAD

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations
Virginia

Project Management

Program Manager:

Julie A Williams-byrd

Project Manager:

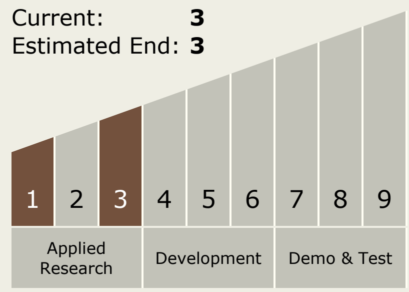
Joseph F Gasbarre

Principal Investigators:

Robert P Damadeo
Charles A Hill

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - └─ TX02.1 Avionics Component Technologies
    - └─ TX02.1.1 Radiation Hardened Extreme Environment Components and Implementations